IGNITION/GLOW PLUG SYSTEM

IGNITION SYSTEM, SERVICING

Ignition system, general information

NOTE:

- **Only the components which specifically relate to the ignition system are dealt with here. For the other components of the injection and ignition system, see MULTIPORT FUEL INJECTION (MFI) .**
- **The engine control module is equipped with On Board Diagnostic (OBD).**
- **Components marked with * are checked via the On Board Diagnostic (OBD), see DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING .**
- **For trouble-free operation of the electrical components a voltage of at least 11.5 V is necessary.**
- **During some checks it is possible that the control module will recognize and store a DTC. Therefore, after completing all checks and repairs the DTC memory must be checked and, if necessary, erased, see DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING .**

Safety precautions, see **SAFETY PRECAUTIONS**

Test data, spark plugs, see **TEST DATA, SPARK PLUGS**

Safety precautions

To prevent injuries to persons and/or damage to the fuel injection and ignition system, the following must be noted:

- Do not touch or disconnect ignition wiring when the engine is running or being turned at starter speed.
- The ignition must be switched off before connecting or disconnecting injection or ignition system wiring or tester cables.
- If the engine is to be turned at starter speed, without starting:

Observe following if test and measuring instruments are required during a test drive:

WARNING:

- **When driving or riding in an airbag-equipped vehicle, NEVER hold the scan tool or other test equipment in your hands or lap while in motion. Objects between you and the airbag increase the risk of injury in an accident.**

- **During a road test in an airbag-equipped vehicle, test equipment must always be fastened to and operated from the rear seat by a second technician.**

Ignition system components, removing and installing

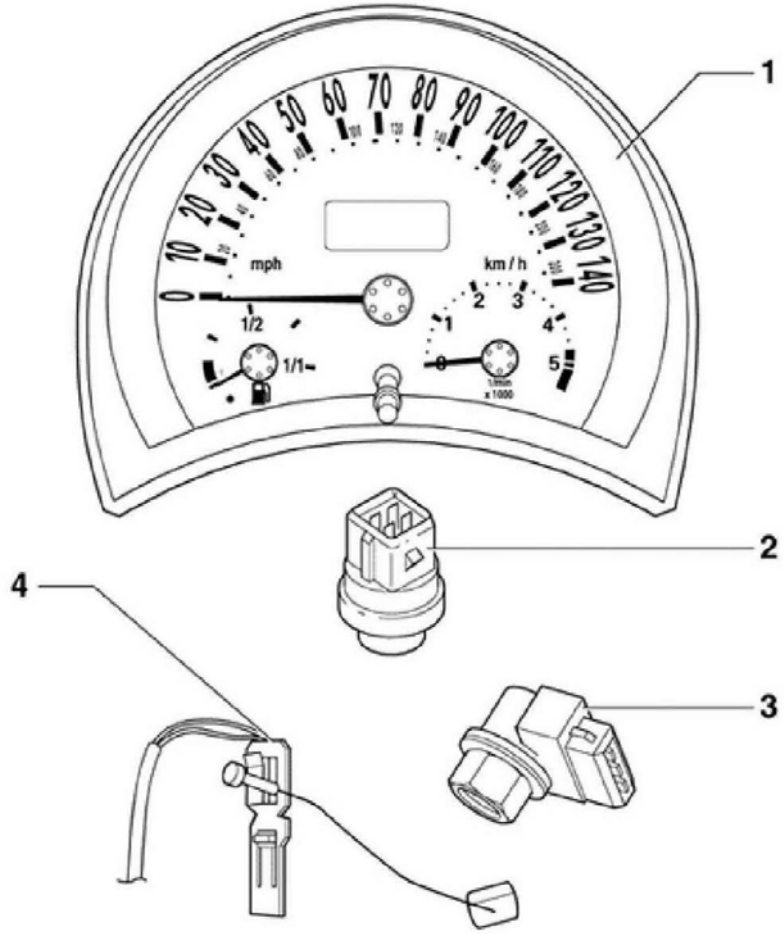
NOTE: Engine control module with connectors, see FUEL INJECTION SYSTEM COMPONENTS, REMOVING AND INSTALLING , item 6.

The following list pertains to **Fig. 1** .

1. **Connector**
   - Black, 4 pin
2. **Ignition coils with power output stages -N70-, -N127-, -N291-, -N292-**
   - Checking, see **IGNITION COILS WITH POWER OUTPUT STAGE, CHECKING**
   - Tighten mounting bolts to 10 Nm
   - Spark plug connector can be pulled off
3. **Seal**
   - Replace if damaged
4. **Spark plug, 30 Nm**
   - Remove and install with spark plug spanner 3122B
   - Type and electrode gap, see **TEST DATA, SPARK PLUGS**
5. **Connector**
   - Black, 3-pin
   - For Camshaft Position (CMP) sensor-G40-
6. **10 Nm**
7. **Camshaft Position (CMP) sensor - G40-***
   - Location, see **COMPONENT LOCATIONS, OVERVIEW** , engine compartment overview
   - Checking, see **CAMSHAFT POSITION (CMP) SENSOR -G40-, CHECKING**
8. **25 Nm**
9. **Washer**
   - Conical
10. **Hood**
    - For Camshaft Position (CMP) sensor -G40-
    - When installing note in arrangement
11. **20 Nm**
    - Tightening torque influences the function of the knock sensor
12. **Knock sensor (KS) 1 -G61-***
    - Sensor and connector contacts are gold-plated

- Checking, see **KNOCK SENSORS, CHECKING**

13. **Connector**
    - Black, 2-pin
    - For Knock sensor (KS) 1 -G61-
    - Sensor and connector contacts are gold-plated
14. **Ground wire**
    - Only loosen or tighten with ignition switched off
15. **10 Nm**
    - Only loosen or tighten with ignition switched off
16. **Connector**
    - Black, 2-pin
    - For Knock sensor (KS) 2 -G66-
    - Sensor and connector contacts are gold-plated
17. **Knock sensor (KS) 2 -G66-***
    - Sensor and connector contacts are gold-plated
    - Checking, see **KNOCK SENSORS, CHECKING**



1 - Instrument cluster - K-

2 - Engine Coolant Temperature (ECT) sensor -G2-

3 - Speedometer Vehicle Speed Sensor (VSS) -G22-

4 - Sender for fuel gauge -G-

G03259900

Fig. 1: Identifying Ignition System Components
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Disconnect 4-pin connector -1- from power output stage for ignition coils (arrow).

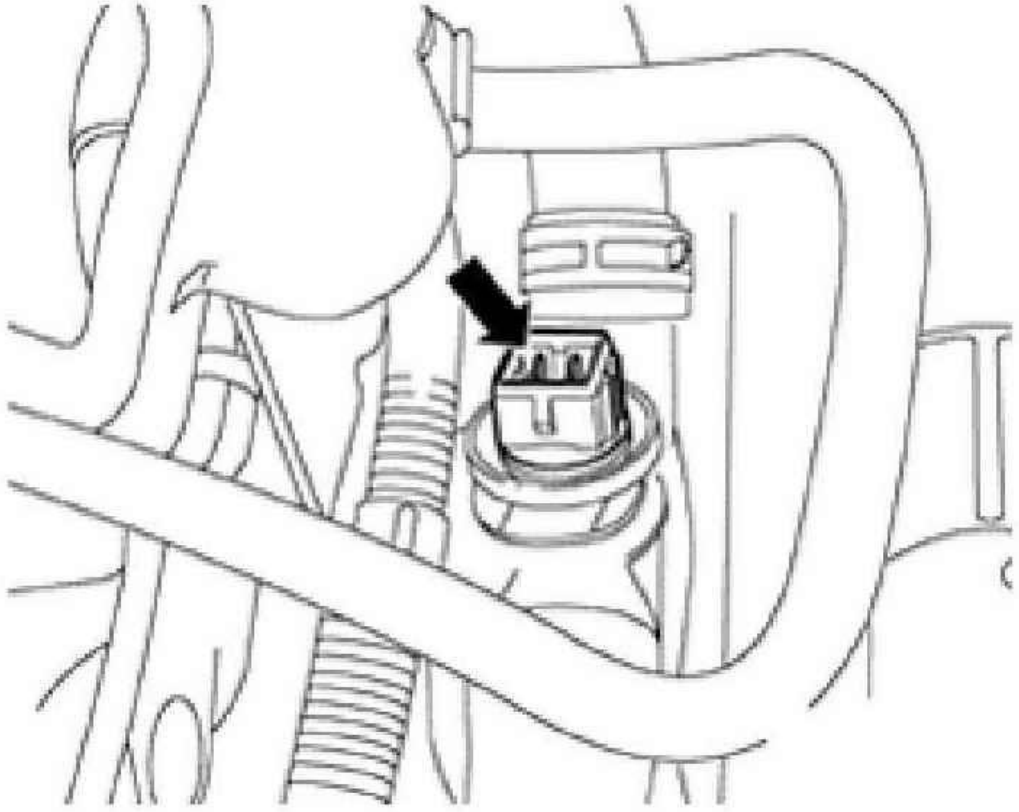
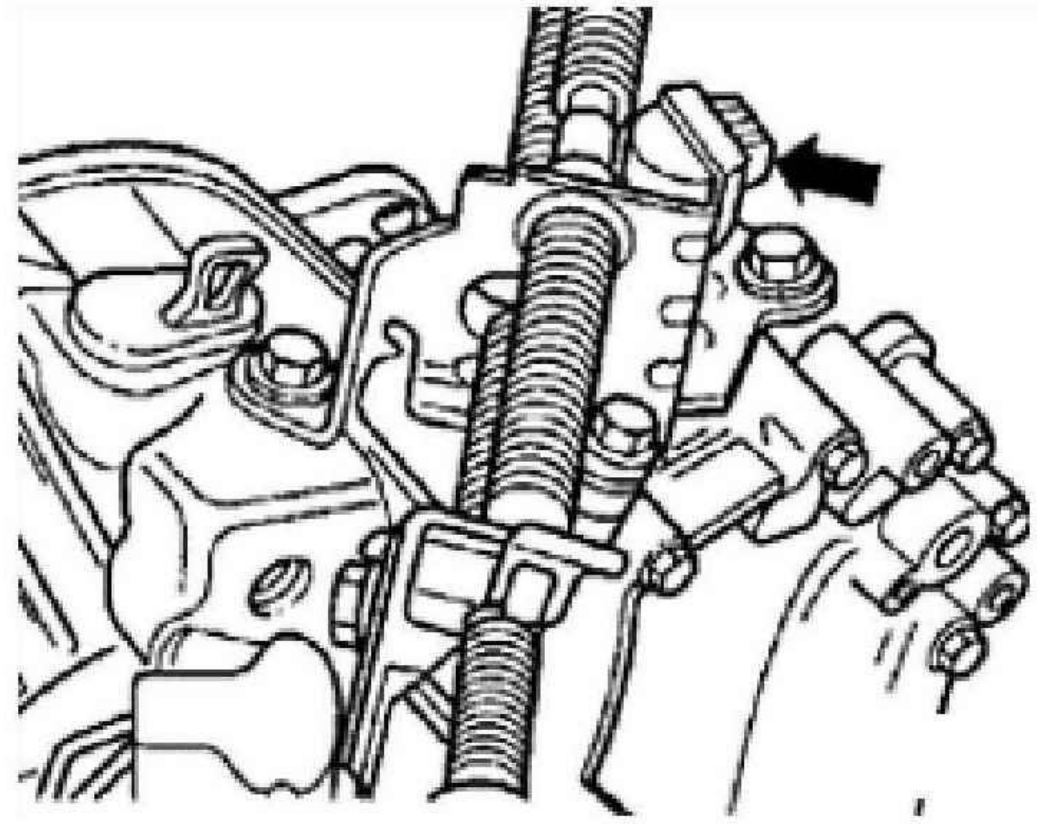


Fig. 2: Disconnecting 4-Pin Connector From Power Output Stage For Ignition Coils
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Pull fuse No. 32 out of fuse holder.



G03259902

Fig. 3: Identifying Fuses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Removing fuse 32 interrupts the voltage supply to the injectors. Fuse holder is located behind access panel at far left end of dash.

Test data, spark plugs

ENGINE CODE

Engine code	**APH**
Firing order	1-3-4-2
Spark plugs(1)	
VW	101 000 063 AA
Manufacturer ID	NGK PFR 6 Q
Electrode gap	max. 0.8 mm

Tightening torque	30 Nm
(1) Remove and install spark plugs with 3122B.	

Camshaft Position (CMP) sensor -G40-, checking

Special tools, test equipment and auxiliary items

- Test box V.A.G 1598/31
- Multimeter Fluke 83 (or equivalent)
- Adapter set V.A.G 1594
- Wiring diagram

Check conditions

- Camshaft Position (CMP) sensor attached tightly
- Battery voltage must be at least 11.5 V

Test sequence

- Disconnect 3-pin connector from Camshaft Position (CMP) sensor -G40- -arrow-.

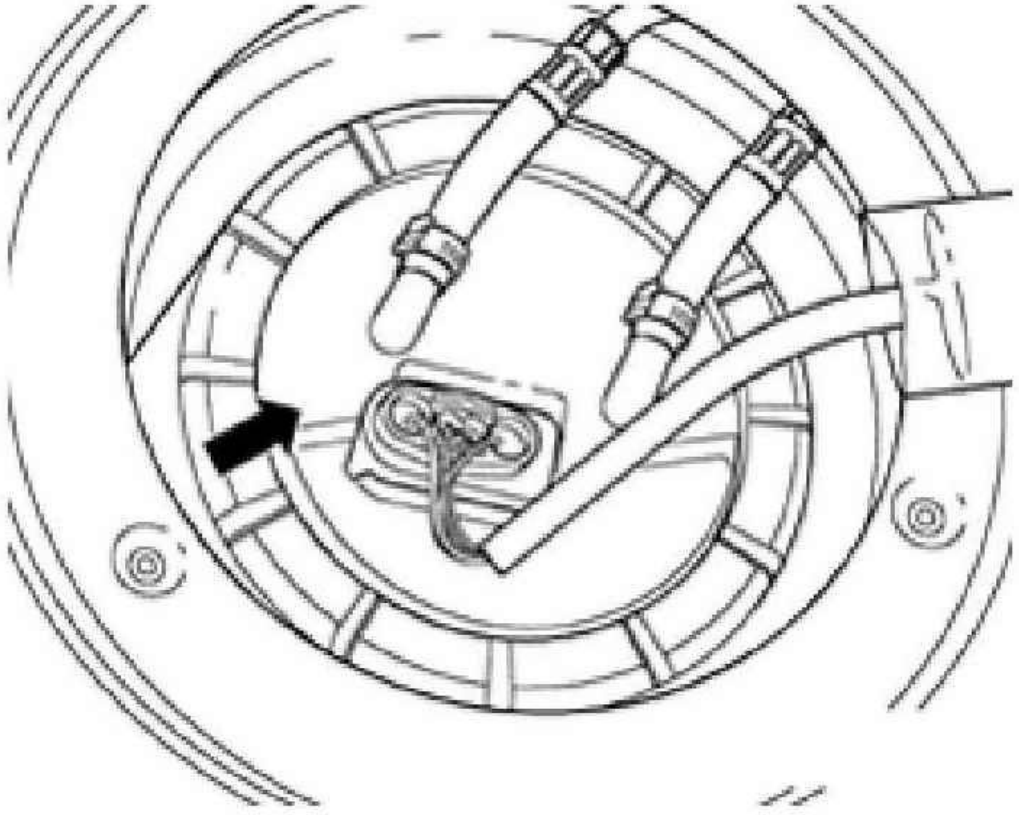


Fig. 4: Disconnecting 3-Pin Connector From Camshaft Position (CMP) Sensor
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Connect multimeter to measure voltage with adapter cables from V.A.G 1594 to contacts 1 (positive) and 3 (Ground) on Camshaft Position (CMP) sensor connector.

Fig. 5: Measuring Voltage Between CMP Sensor Harness Connector Terminals 1 And 3
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Switch on ignition.

  Specification: min. 4.5 V

- Switch off ignition.

  If no voltage is present:

- Remove inner plenum chamber cover, left:

See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Connect test box V.A.G 1598/31 to control module wiring harness. Engine control module is not connected by this action.

Fig. 6: Connecting Test Box V.A.G 1598/31
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring for open circuit between test box and connector using wiring diagram.

Fig. 7: Identifying CMP Sensor Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Contact 1 + socket 98
- Contact 2 + socket 86
- Contact 3 + socket 108

Wire resistance: Max. 1.5 ohm

- Additionally check wires for short to one another.

Specification: INFINITY ohm

If no malfunctions in wiring are detected and voltage was present between contacts 1 + 3:

- Replace Camshaft Position (CMP) sensor -G40-, see item 7 .

- Check DTC memory, if necessary, repair any malfunctions and then erase DTC memory, see **DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING** .
- Read readiness code, see **READINESS CODE, DISPLAYING** . If DTC memory has been erased or engine control module was disconnected from permanent positive, readiness code must be generated again, see **READINESS CODE, GENERATING** .

If no malfunction in wiring is detected and no voltage was present between contacts 1 + 3:

- Replace engine control module, see **ENGINE CONTROL MODULE (ECM), REPLACING** .

Ignition coils with power output stage, checking

Special tools, test equipment and auxiliary items

- Test box V.A.G 1598/31
- Multimeter Fluke 83 (or equivalent)
- Diode test lamp V.A.G 1527
- Adapter set V.A.G 1594
- Wiring diagram

Check conditions

- Fuse 29 must be OK

NOTE: Fuse holder is located behind access panel at far left end of dash.

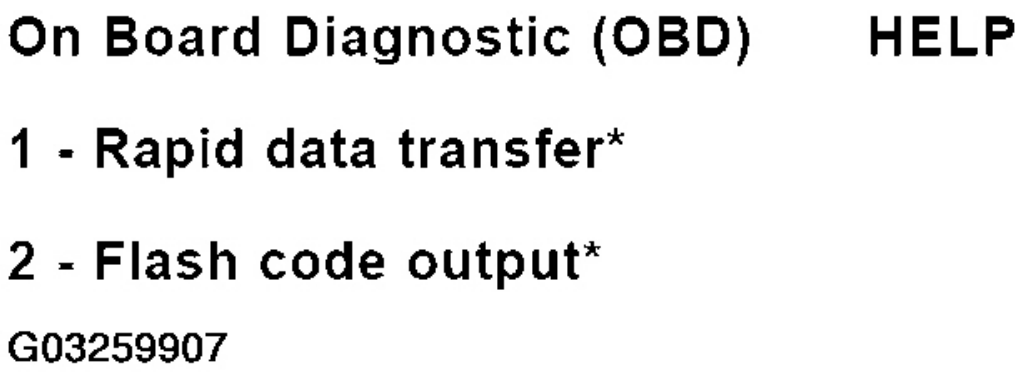


Fig. 8: Identifying Fuses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Battery voltage must be at least 11.5 V
- Camshaft Position (CMP) sensor must be OK, checking, see **CAMSHAFT POSITION (CMP) SENSOR -G40-, CHECKING**
- Engine speed sensor must be OK, checking, see **ENGINE SPEED (RPM) SENSOR -G28-, CHECKING**

Test sequence

NOTE: Ignition coils and final power output stages are one component and cannot be replaced individually.

- Disconnect 4-pin connector -1- off power output stage for ignition coils (arrow).

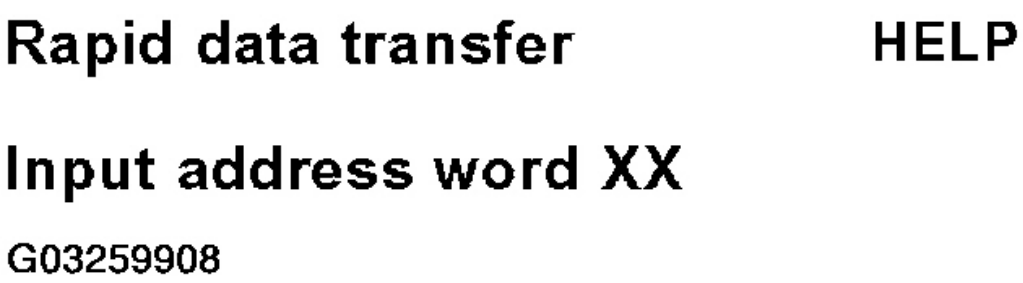


Fig. 9: Disconnecting Ignition Coil Power Output Stage 4-Pin Connector
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Checking voltage supply

- Using multimeter and adapter cables from V.A.G 1594 measure supply voltage between contacts 1 + 2 and 1 + 4 of disconnected connector.
- Switch on ignition.

  Specification: Min. 11.5 V

- Switch off ignition.

Fig. 10: Identifying Ignition Coil Power Output Stage 4-Pin Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If no voltage is present:

- Check wire between 4 -pin connector contact 2 and relay plate for open circuit according to wiring diagram.

  Wire resistance: max. 1.5 ohm

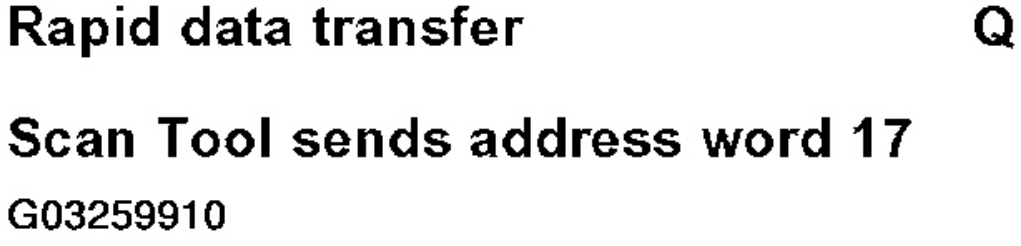


Fig. 11: Identifying Ignition Coil Power Output Stage 4-Pin Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring between 4 -pin connector and Ground (GND) for open circuit according to wiring diagram.
  - Terminal 2 and Ground (GND)
  - Terminal 4 and Ground (GND)

  Wire resistance: max. 1.5 ohm

If there is no malfunction in the supply voltage:

- Check activation, see **CHECKING ACTIVATION** .

Checking activation

WARNING: During the following test do not touch the connecting parts of the ignition coils or test cables.

- Pull fuse No. 32 out of fuse holder.

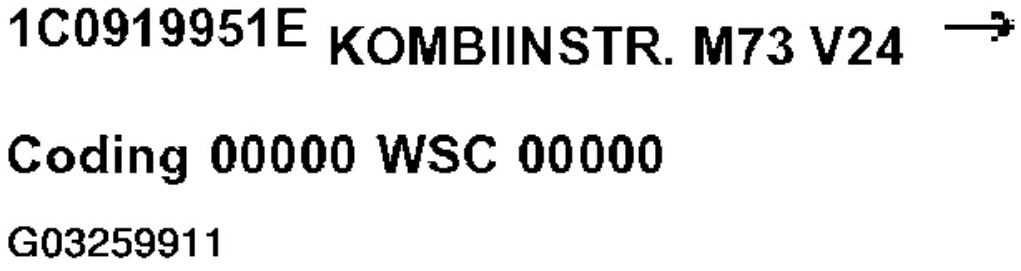


Fig. 12: Identifying Fuses
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Removing fuse 32 interrupts the voltage supply to the injectors. Fuse holder is located behind access panel at far left end of dash.

- Connect diode test lamp V.A.G 1527 with adapter cables from V.A.G 1594 to contacts of disconnected connector

  Contacts 2 + 3

Fig. 13: Identifying Ignition Coil Power Output Stage 4-Pin Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Operate starter and check ignition signal from engine control module.

  LED must flicker

- Switch off ignition.

When the LED flickers and the supply voltage is OK:

- Replace relevant ignition coil with power output stage, see item 2 .
- Check DTC memory, if necessary, repair any malfunctions and then erase DTC memory, see **DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING** .
- Read readiness code, see **READINESS CODE, DISPLAYING** . If DTC memory has been erased or engine control module was disconnected from permanent positive, readiness code must be generated again, see **READINESS CODE, GENERATING** .

  If LED does not flicker:

- Check wiring, see **CHECKING WIRING** .

Checking wiring

- Remove inner plenum chamber cover, left:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING**

- Connect test box V.A.G 1598/31 to control module wiring harness. Engine control module is not connected by this action.

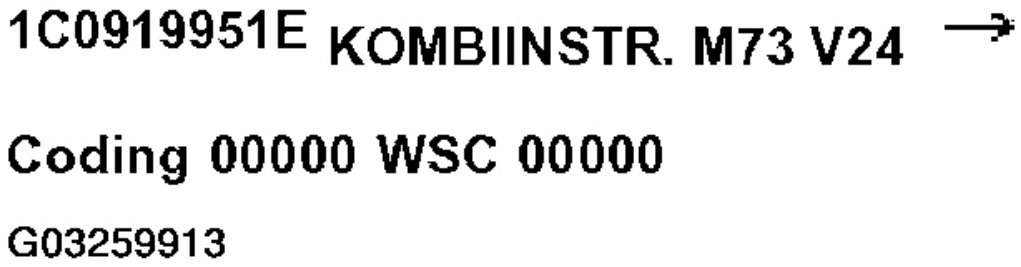


Fig. 14: Connecting Test Box V.A.G 1598/31

Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring between test box and 4 -pin connector for open circuit according to wiring diagram.
  - Cylinder 1 contact 3 + socket 102
  - Cylinder 2 contact 3 + socket 95
  - Cylinder 3 contact 3 + socket 103
  - Cylinder 4 contact 3 + socket 94

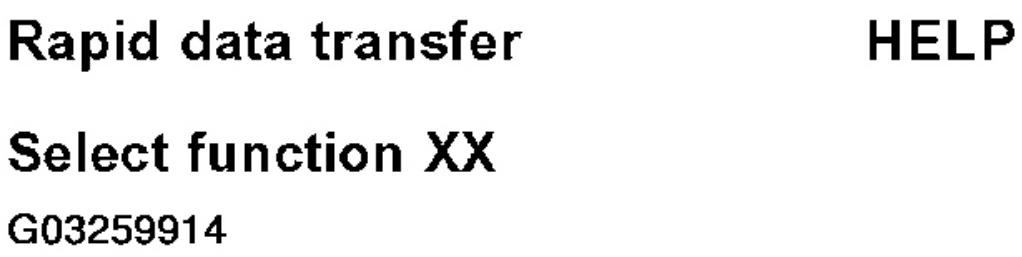


Fig. 15: Identifying Ignition Coil Power Output Stage 4-Pin Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

Wire resistance: Max. 1.5 ohm

- Additionally check wires for short to one another.

  Specification: INFINITY ohm

  If no malfunction can be found in the wiring:

- Replace Engine Control Module (ECM), see **ENGINE CONTROL MODULE (ECM), REPLACING** .

Knock sensors, checking

NOTE:

- **It is extremely important to keep to the tightening torque of 20 Nm to ensure the knock sensors perform perfectly.**

- Only gold-plated contacts may be used when servicing the knock sensor connector contacts.

Special tools, test equipment and auxiliary items

- Scan tool V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3B
- Test box V.A.G 1598/31

- Multimeter Fluke 83 (or equivalent)
- Adapter set V.A.G 1594
- Wiring diagram

Check conditions

- On Board Diagnostic (OBD) must have recognized a malfunction in one or both knock sensors, see **DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING**
- Coolant temperature must be at least 85 °C, see display group 28, display zone 3

Checking function

- Connect scan tool V.A.G 1551 ((V.A.G 1552). Start engine and select "Address word" 01 of engine control module. Engine must be running at idle speed. Connecting scan tool and selecting engine control module, see **V.A.G 1551 SCAN TOOL, CONNECTING AND SELECTING ENGINE CONTROL MODULE** .

Indicated on display

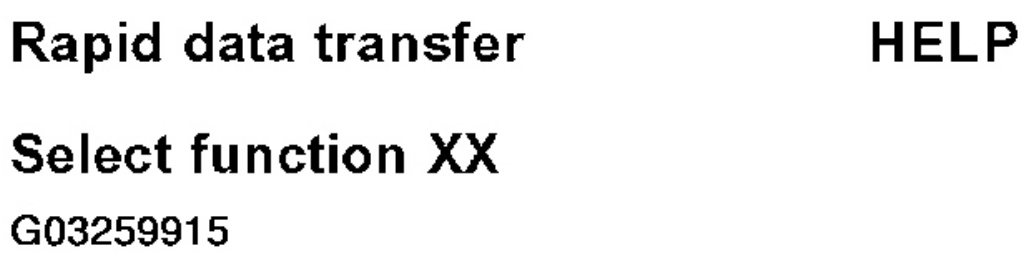


Fig. 16: VAG 1551 Scan Tool Display - Checking Knock Sensor (1 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press keys 0 and 8 for function "Read measured value block" and confirm entry with Q key.

Indicated on display

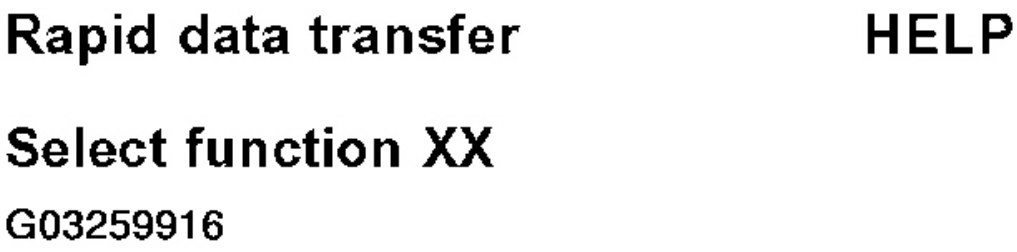


Fig. 17: VAG 1551 Scan Tool Display - Checking Knock Sensor (2 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press keys 0, 2 and 8 for "Display group number 28" and confirm entry with Q key.

Indicated on display (1-4 Display zones)

Fig. 18: VAG 1551 Scan Tool Display - Checking Knock Sensor (3 Of 3)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

NOTE: Checking the knock sensors must be performed during a test drive because the knock sensors OBD is not activated until the engine speed exceeds 2000 RPM and the engine is loaded by more than 40 %.

- Perform a test drive and check knock control specifications on display (display zone 4).

Observe the valid safety precautions when performing a test drive, see **SAFETY PRECAUTIONS** .

DISPLAY GROUP 28: IGNITION, KNOCK CONTROL

	Display zones			
	1	**2**	**3**	**4**
Display group 28: ignition, knock control				
Display	xxxx RPM	xxx.x %	xxx.x °C	Test OFF/Test ON Syst. OK. Syst. n. OK.
Indicated	Engine speed (in steps of 40)	Engine load	Coolant temperature	OBD condition and OBD result
Working range	0-6800 RPM	0.0 - 100.0 %	-45.0 -143.0 °C	-
Specification	at least 2000 RPM	> 40.0 %	85.0 -105.0 °C	Syst. OK.
	-	-	-	If the specifications are not achieved, see **CONTINUATION:**

If the specification is attained:

- Press --> key.
- Press keys 0 and 6 for function "End output" and confirm entry with Q key.
- Switch off ignition.

Continuation:

If the specifications are not obtained:

- Press --> key.
- Press keys 0 and 6 for function "End output" and confirm entry with Q key.
- Switch off ignition.
- Separate 2-pin connector to Knock sensor 1 -G61- -1- and/or 2 - pin connector to Knock sensor 2 -G66- -2-.

Fig. 19: Separating 2-Pin Connector To Knock Sensors
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Measure resistance between contacts 1 + 2 at connections to knock sensors.

Specification INFINITY ohm

Fig. 20: Measuring Resistance Between Contacts 1 And 2 At Knock Sensor Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

If the specification is not obtained:

- Replace Knock sensor/s -G61- or -G66-, see item 12 or item 17 .
- Check DTC memory, if necessary, repair any malfunctions and then erase DTC memory, see **DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING** .
- Read-out readiness code, see **READINESS CODE, DISPLAYING** . If DTC memory has been erased or engine control module was disconnected from permanent positive, readiness code must be generated again, see **READINESS CODE, GENERATING** .

If the specification is obtained:

- Check wiring, see **CHECKING WIRING** .

Checking wiring

- Remove inner plenum chamber cover, left:

  See **PLENUM CHAMBER INNER COVER, REMOVING AND INSTALLING** .

- Connect test box V.A.G 1598/31 to control module wiring harness. Engine control module is not connected by this action.

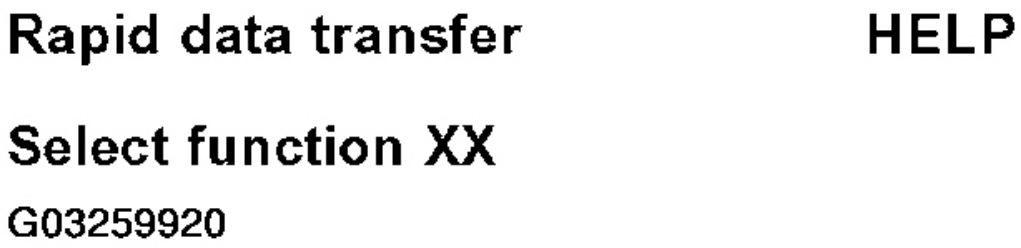


Fig. 21: Connecting Test Box V.A.G 1598/31 To Control Module Wiring Harness
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Check wiring between test box and 2 -pin connector for open circuit using wiring diagram.

  -G61- -G66-

  Contact 1 + socket 106 107

  Contact 2 + socket 99 99

  Wire resistance: Max. 1.5 ohm

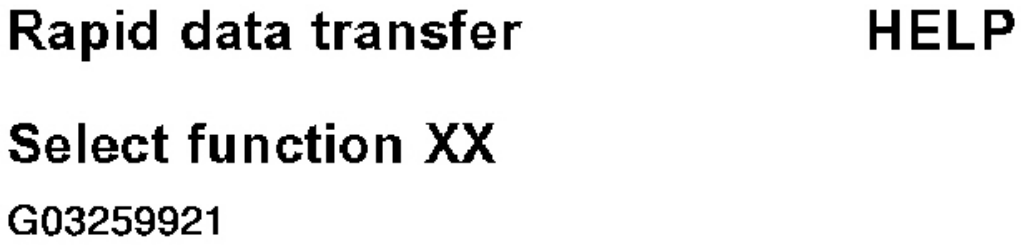


Fig. 22: Identifying Knock Sensor 2-Pin Harness Connector Terminals
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Additionally check wires at socket 99 for short to sockets 106 and 107.

Specification: INFINITY ohm

If no malfunctions in wiring are detected:

- Loosen knock sensor and tighten again to 20 Nm.
- Perform a test drive again and check knock control specifications on display.

During the road test coolant temperature must exceed 85 °C

When the temperature is reached, the operating conditions must be attained several times:

- Idle
- Part throttle
- Wide open throttle
- Overrun

- At Wide open throttle the speed must exceed 3500 RPM.

- Again check control module DTC memory.

If the malfunction is still present:

- Replace Knock sensor/s -G61- or -G66-, see item 12 or item 17 .
- Check DTC memory, if necessary, repair any malfunctions and then erase DTC memory, see **DIAGNOSTIC TROUBLE CODE (DTC) MEMORY, CHECKING AND ERASING** .
- Read readiness code, see **READINESS CODE, DISPLAYING** . If DTC memory has been erased or engine control module was disconnected from permanent positive, readiness code must be generated again, see **READINESS CODE, GENERATING** .

Misfiring recognition, checking

Special tools, test equipment and auxiliary items

- Scan tool V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3B

Test sequence

- Connect scan tool V.A.G 1551 ((V.A.G 1552). Start engine and select "Address word" 01 of engine control module. engine must be running at idle speed. (Connecting scan tool and selecting engine control module, see **V.A.G 1551 SCAN TOOL, CONNECTING AND SELECTING ENGINE CONTROL MODULE**).

Indicated on display

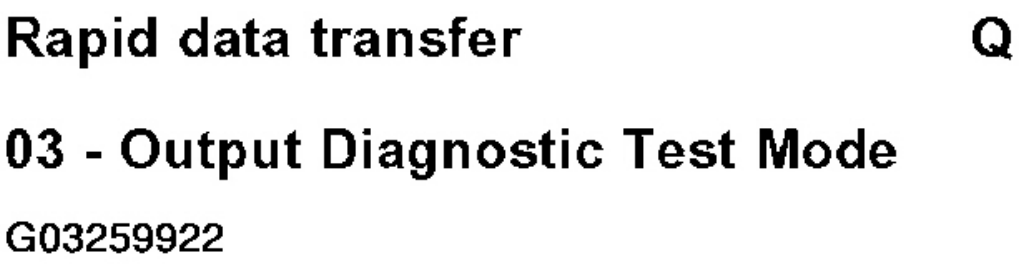


Fig. 23: VAG 1551 Scan Tool Display - Checking Misfiring Recognition (1 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press keys 0 and 8 for function "Read measured value block" and confirm entry with Q key.

Indicated on display

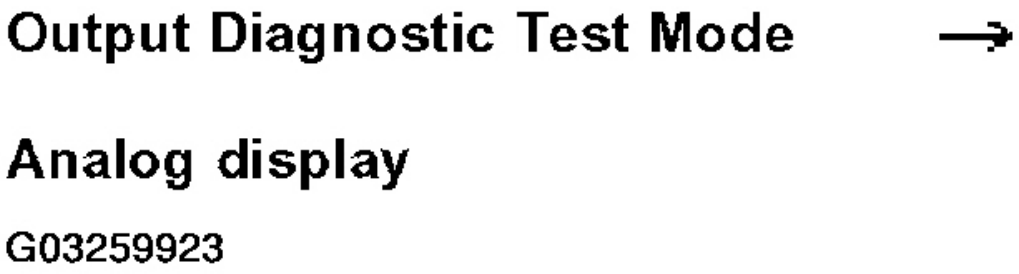


Fig. 24: VAG 1551 Scan Tool Display - Checking Misfiring Recognition (2 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Press keys 0, 1 and 4 for "Display group number 14" and confirm entry with Q key.

Indicated on display (1-4 Display zones)

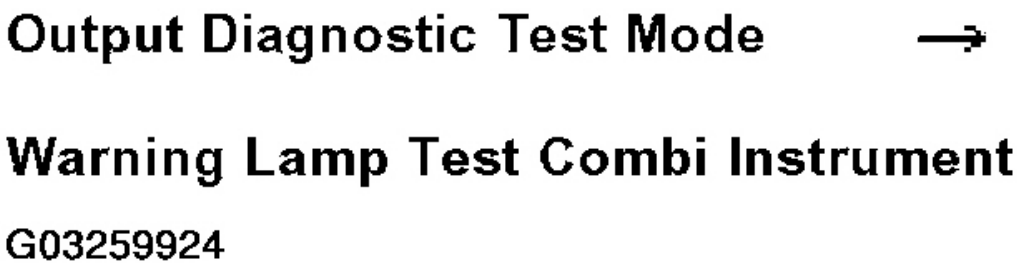


Fig. 25: VAG 1551 Scan Tool Display - Checking Misfiring Recognition (3 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Increase engine speed until display field 4 indicates status -Misfire recognition activated -.
- Check total number of misfires in display zone 3.

DISPLAY GROUP 14: IGNITION, MISFIRE RECOGNITION

	Display zones			
	1	**2**	**3**	**4**
Display group 14: ignition, misfire recognition				
Display	xxxx RPM	xxx.x %	xxx	Activated Blocked
Indicated	Engine speed (in 40 steps)	Engine load	Catalyst damaging misfires (Total)	Misfire recognition status
Working range	0-6800 RPM	0.0 -100.0 %	0-65000	-
Specification	-	>14.0 %	0	activated

If the specification is not obtained, see **EVALUATING DISPLAY GROUP 14, DISPLAY ZONE 3 - TOTAL NUMBER OF CATALYST DAMAGING MISFIRES** , Evaluating display group 14

If the specifications are obtained:

- Press key.
- Press keys 0 and 6 for "End output" function and confirm input with Q key.
- Switch off ignition.

If the specifications are not attained:

- Change to display group 15 as follows:
- Press key 3 ((V.A.G 1551) or key UPARROW (V.A.G 1552).

Indicated on display (1-4 Display zones)

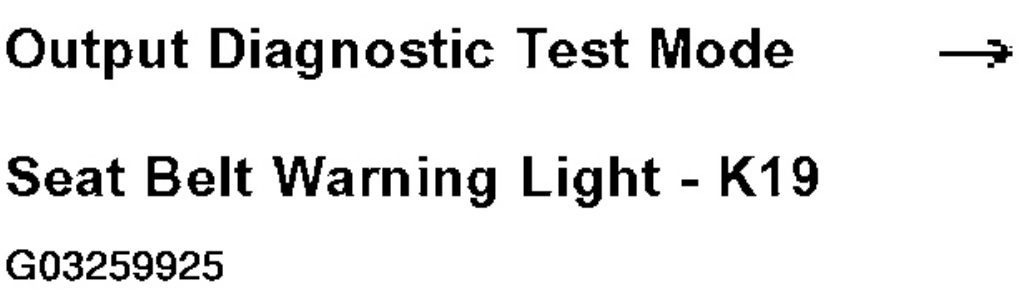


Fig. 26: VAG 1551 Scan Tool Display - Checking Misfiring Recognition (4 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Increase engine speed until display field 4 indicates status - Misfire recognition activated -.
- Check misfiring in display zones 1 -3.

DISPLAY GROUP 15: IGNITION, MISFIRE RECOGNITION

	Display zones			
	1	**2**	**3**	**4**
Display group 15: ignition, misfire recognition				
Display	xxx	xxx	xxx	Activated Blocked
Indicated	Catalyst damaging misfires Cyl. 1	Catalyst damaging misfires Cyl. 2	Catalyst damaging misfires Cyl. 3	Misfire recognition status
Working range	0-65000	0-65000	0-65000	-
Specification	0	0	0	activated

If the specification is not obtained, see **EVALUATING DISPLAY GROUP 14, DISPLAY ZONE 3 - TOTAL NUMBER OF CATALYST DAMAGING MISFIRES** , Evaluating display groups 15 and 16

If the specifications are obtained:

- Change to display group 16 as follows:
- Press key 3 ((V.A.G 1551) or key UPARROW (V.A.G 1552).

Indicated on display (1 and 4 Display zones)

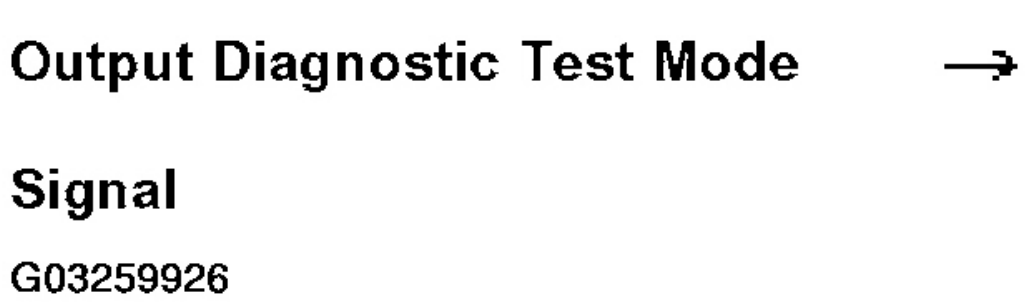


Fig. 27: VAG 1551 Scan Tool Display - Checking Misfiring Recognition (5 Of 5)
Courtesy of VOLKSWAGEN OF AMERICA, INC.

- Increase engine speed until display field 4 indicates status -Misfire recognition activated -.
- Check misfiring in display zone 1.

DISPLAY GROUP 16: MISFIRING RECOGNITION

	Display zones			
	1	2	3	4
Display group 16: misfiring recognition				
Display	xxx	-	-	Active Blocked
Indicated	Exhaust damaging misfires Cyl. 4	-	-	Misfire status recognition
Working range	0-65000	-	-	-
Specification	0	-	-	activated

If the specification is not obtained, see **EVALUATING DISPLAY GROUP 14, DISPLAY ZONE 3 - TOTAL NUMBER OF CATALYST DAMAGING MISFIRES** , Evaluating display groups 15 and 16

- Press --> key.
- Press keys 0 and 6 for "End output" function and confirm input with Q key.
- Switch off ignition.

Evaluating display group 14, display zone 3 - total number of catalyst damaging misfires

EVALUATING DISPLAY GROUP 14, DISPLAY ZONE 3 - TOTAL NUMBER OF CATALYST DAMAGING MISFIRES

Appears on display	Possible malfunction cause	Malfunction elimination
Larger 0	• Spark plug malfunctioning • Ignition coil	• Check spark plugs, see **IGNITION SYSTEM, SERVICING**

	malfunctioning • Power output stage for ignition coil malfunctioning	• Check ignition coils with power output stage, see **IGNITION COILS WITH POWER OUTPUT STAGE, CHECKING**
	• Injector malfunctioning	• Check injectors, see **FUEL INJECTORS, CHECKING**

Evaluating display group 15 display zones 1 to 4/display group 16 display zones 1 and 4 - catalyst damaging misfires Cyl. 1 to Cyl. 4

EVALUATING DISPLAY GROUP 15 DISPLAY ZONES 1 TO 4/DISPLAY GROUP 16 DISPLAY ZONES 1 AND 4 - CATALYST DAMAGING MISFIRES CYL. 1 TO CYL. 4

Appears on display	Possible malfunction cause	Malfunction elimination
Larger 0	• Spark plug malfunctioning • Ignition coil malfunctioning • Power output stage for ignition coil malfunctioning	• Check spark plugs, see **IGNITION SYSTEM, SERVICING** • Check ignition coils with power output stage, see **IGNITION COILS WITH POWER OUTPUT STAGE, CHECKING**
	• Injector malfunctioning	• Check injectors, see **FUEL INJECTORS, CHECKING**